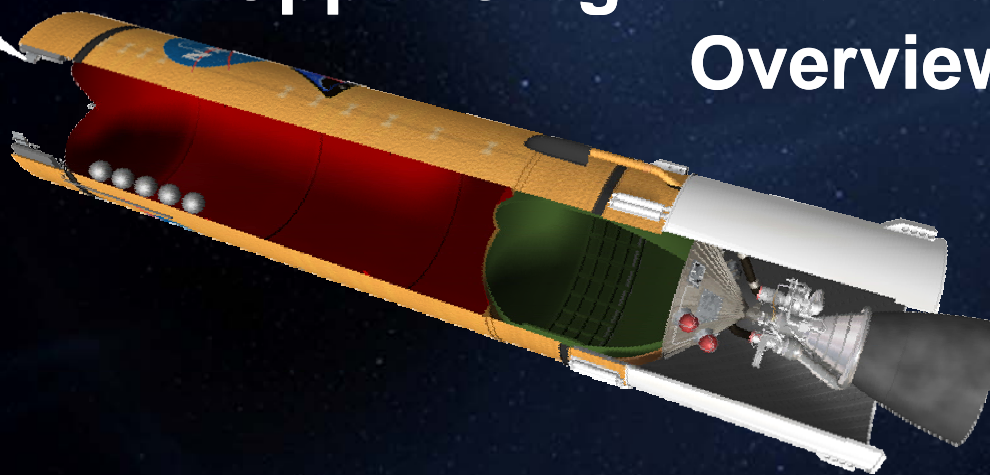


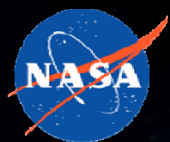


Charles L. Nola  
Ares I Upper Stage Element  
July 23, 2008



## Ares I Crew Launch Vehicle Upper Stage Avionics and Software Overview



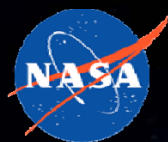


# Introduction

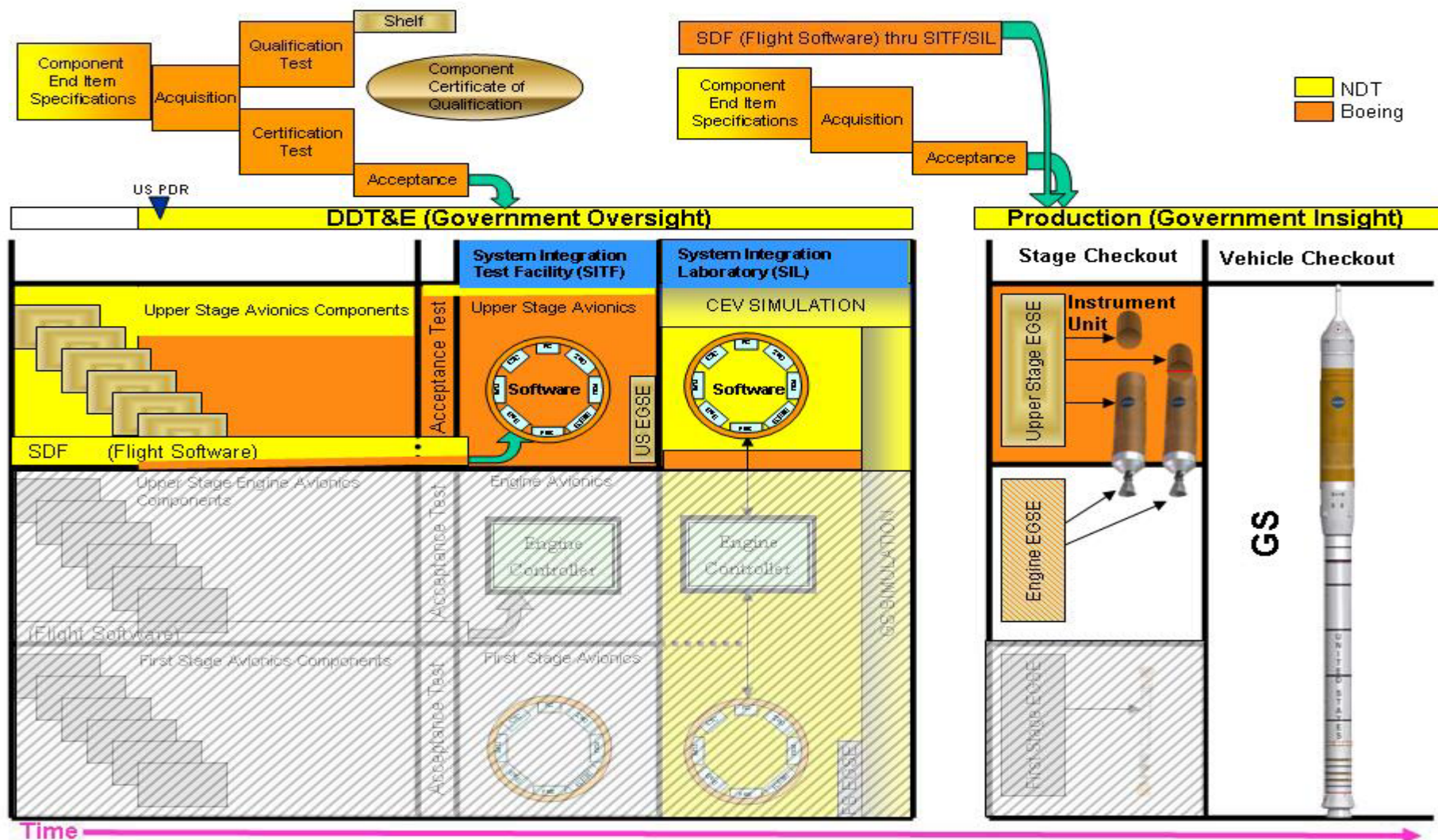


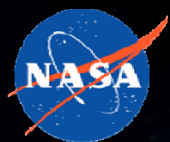
- ◆ **“Avionics” refers to the on-board electronics that guide and control the Ares I Crew Launch Vehicle (CLV).**
- ◆ **NASA is leading the design of the Avionics System, and The Boeing Company is the Avionics production contractor.**
- ◆ **Design lead responsibility builds on the legacy of the Saturn development model (NASA design and IBM production).**
- ◆ **NASA Design Team (NDT) can establish an architectural philosophy and system design that provides for a low-risk development through:**
  - Seeking available component solutions
  - Design for production
  - Design for obsolescence
  - An architecture that economically accommodates change
- ◆ **Approach allows NASA to consider future Constellation vehicles and spacecraft and leverage opportunities.**





# IUA Team - Development Approach Roadmap





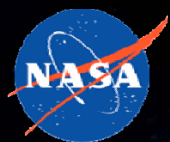
# Ares I US Avionics and Software Development Approach



## ◆ NASA designs and maintains design ownership throughout all phases

- NDT architects and specifies
- NDT assures a viable system design
- Instrument Unit Avionics (IUA) contract is awarded prior to US PDR
  - Influences design for manufacturability, producibility, and sustainability
  - Analysis and development plans for the manufacture, assembly, checkout, logistics, and sustaining
  - Provides development hardware
  - Integrates and Tests the Upper Stage Avionics System
  - Specifying the Upper Stage Electrical Ground Support Equipment
  - Providing the Upper Stage Avionics Systems and EGSE for flight tests and production flights
  - Establish the manufacturing and production areas
  - IUAC will transition to sustaining engineering role with NASA performing an insight role after Design Certification Review
- NDT leads the Flight Software Design Development Test & Evaluation

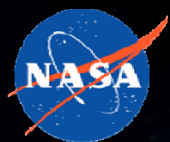




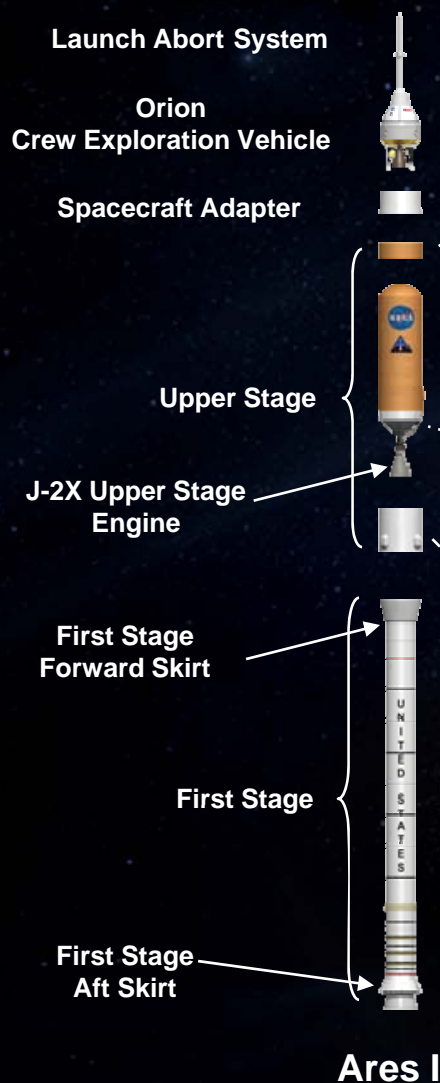
# NDT Responsibilities



- ◆ **The NASA Design Team is responsible for the US Avionics System Design, Development, and Test**
  - Analyses, Trades, and establishment of margins and system resource management required to demonstrate Avionics System (including software) design meets mission requirements
  - Establishment and management of the system development and test program resulting in design certification
  
- ◆ **The NASA Design Team is responsible for Avionics System-level requirements and specifications:**
  - Upper Stage Element Level Requirements (Element Requirements Document)
  - Upper Stage Avionics System-level Architecture (Hardware and Software)
  - Avionics and Software Subsystem Specification
  - Component End Item Specifications
  - Electrical Ground Support System Requirements
  
- ◆ **The NASA Design Team is responsible for Avionics System-level development and test plans:**
  - Avionics System Development Plan
  - Avionics System Test Plan
  
- ◆ **The NASA Design Team is responsible for Flight Software development:**
  - All Flight Software Design, Development, Test, and Evaluation, through Certification for flight
  
- ◆ **The NASA Design Team is responsible for development and test facilities:**
  - Software Development Facility
  - System Integrated Test Facility
  - System Integrated Laboratory

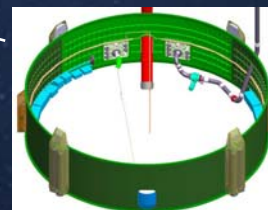


# Ares I Upper Stage Avionics Locations



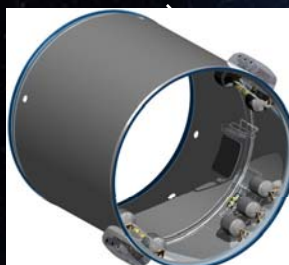
## Instrumentation Unit

- Flight Computers
- Command & Telemetry Computers
- Vehicle Flight Software
- Inertial Navigation System
- Data Acquisition & Control Units
- Radio Frequency Communication System
- Power Distribution & Control Unit
- Battery Unit
- Flight Safety System
- Global Positioning System
- Operational Flight Instrumentation (OFI)
- Developmental Flight Instrumentation (DFI)



## Aft Skirt

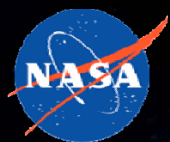
- Combined Control System Electronics
- Data Acquisition & Control Unit
- Power Distribution & Control Unit
- Battery Unit
- OFI & DFI



## Interstage

- Roll Control System Electronics
- Rate Gyro Assemblies
- Pump Motor Inverter Unit
- Power Distribution & Control Unit
- Battery Unit
- OFI & DFI





# Ares I Overall Avionics & Software Functions

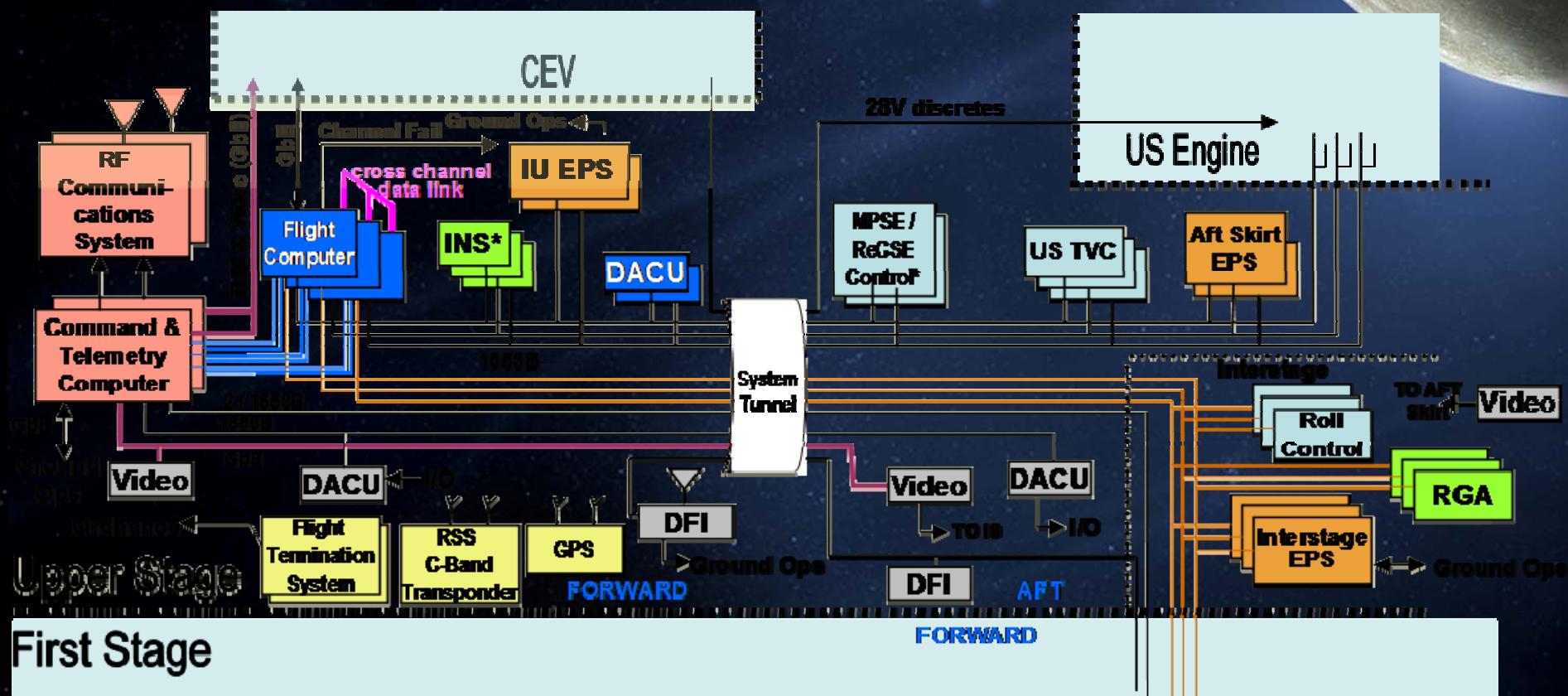


## ◆ Upper Stage Avionics Primary Functional Responsibilities

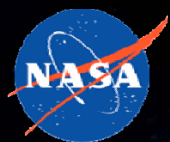
- Pre-flight Checkout
- Guidance Navigation & Control of Integrated Vehicle
- Vehicle Management
  - Command and Data Handling
  - Autonomous and Automated Control of Upper Stage Subsystems
  - Ground and Crew command capability
  - Fault Detection, Diagnostics, and Response (including Abort Recommendations)
  - OFI and DFI Telemetry
  - Support Range Tracking
  - Flight Termination Implementation



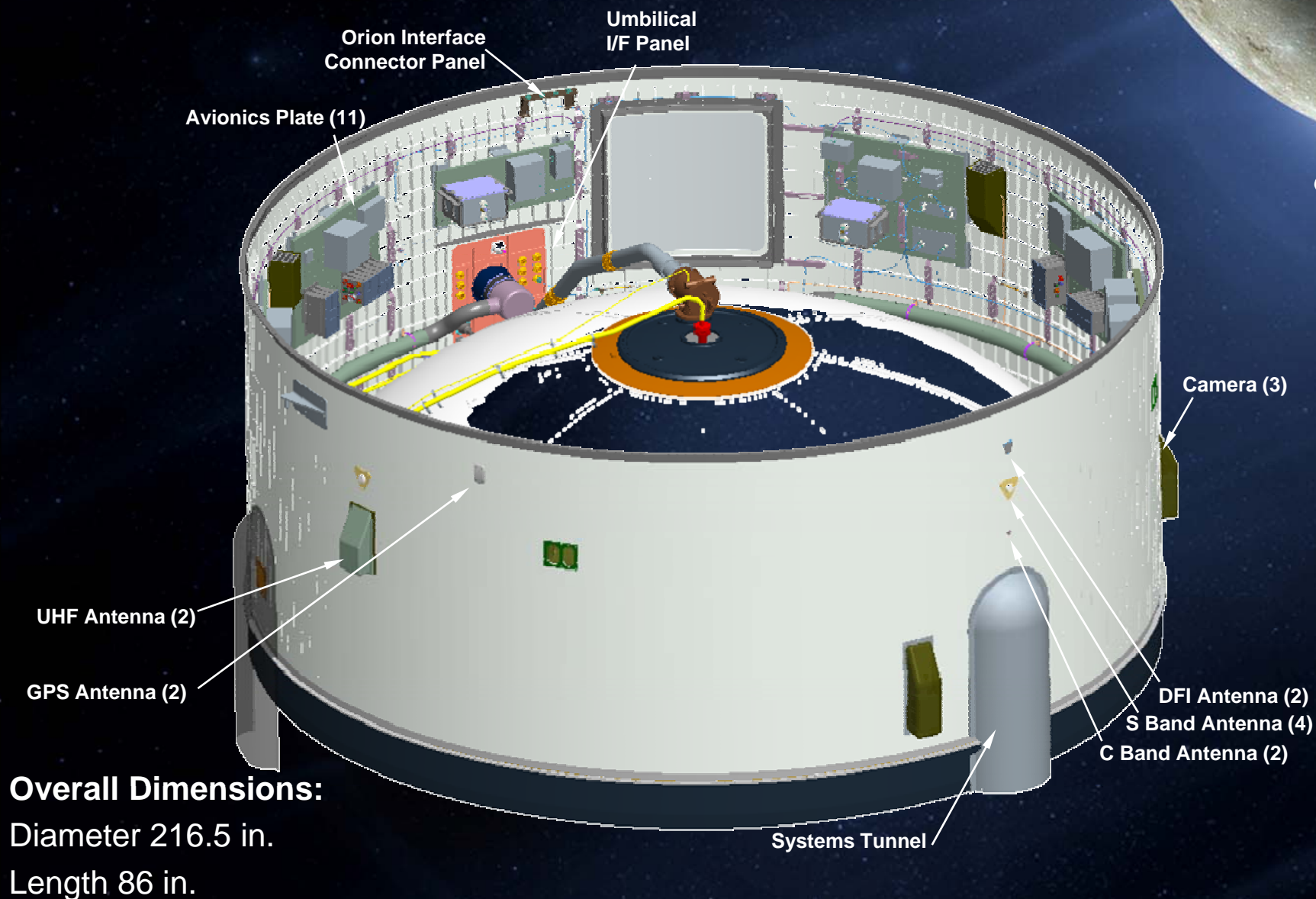
# Block Diagram Version of Avionics Architecture





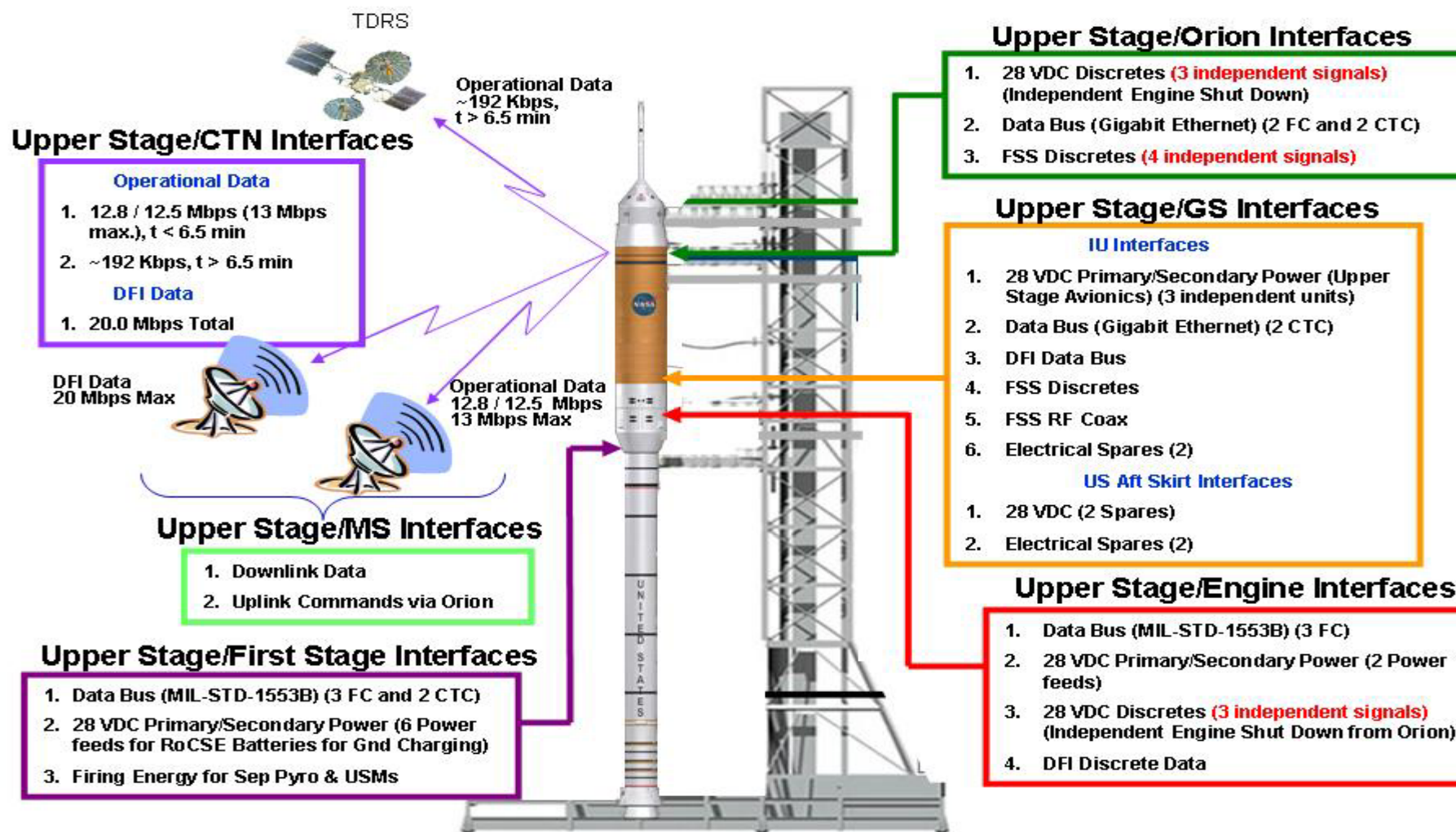


# Instrument Unit Avionics Preliminary Design

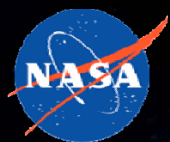




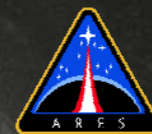
# Upper Stage Avionics External Interfaces







## Conclusion



- ◆ **The NASA Design Team (NDT) has planned a development approach that implements within the larger Constellation framework.**
- ◆ **NASA-owned and led design has already resulted in cost savings through competition, and provides the mechanisms to further reduce cost through early design influence for production.**
- ◆ **NASA and Boeing personnel work are working together in a “One Team” approach**
- ◆ **This strategy leverages opportunities for NASA’s future Constellation developments.**
- ◆ **Competition, system architecture, and design philosophy all contribute to the Avionics team objectives: (1) Successfully deliver a certified Upper Stage Avionics System to the Project, and (2) Maintain lower life-cycle cost.**